

## CLAIMS

1. A semiconductor structure comprising:  
a monocrystalline silicon substrate ;  
5 an amorphous oxide material overlying the monocrystalline silicon substrate ;  
a monocrystalline perovskite oxide material overlying the amorphous oxide material ;  
a monocrystalline compound semiconductor material overlying the monocrystalline perovskite oxide material; and  
10 an arrayed wavelength grating device overlying the monocrystalline silicon substrate .
2. The semiconductor structure of claim 1, wherein:  
the arrayed wavelength grating device functions as a multiplexer.
- 15 3. The semiconductor structure of claim 1, wherein:  
the arrayed wavelength grating device functions as a demultiplexer.
4. The semiconductor structure of claim 1, wherein:  
20 the arrayed wavelength grating device functions as a router.
5. The semiconductor structure of claim 1, wherein:  
the arrayed wavelength grating device functions as a switch.
- 25 6. The semiconductor structure of claim 1, wherein:  
a temperature sensitivity of the arrayed wavelength grating device is tunable.
7. The semiconductor structure of claim 1, wherein:  
a polarization dependent wavelength of the arrayed wavelength grating device  
30 is tunable.

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8. The semiconductor structure of claim 1, wherein:  
a channel wavelength offset of the arrayed wavelength grating device is tunable.

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9. The semiconductor structure of claim 1, wherein:  
the arrayed wavelength grating device includes

a plurality of electro-optical waveguides formed within the monocrystalline compound semiconductor layer, each waveguide of the plurality of  
10 electro-optical waveguides carrying an optical signal of a distinct wavelength, and  
a first electrode formed in the monocrystalline compound semiconductor layer and above the plurality of electro-optical waveguides, the first electrode operable to provide a distinct phase shift to each waveguide of the plurality of electro-optical waveguides in response to an application of voltage to the first  
15 electrode.

10. The semiconductor structure of claim 9, wherein:  
the arrayed wavelength grating device further includes  
a planar waveguide region in optical communication with the plurality  
20 of electro-optical waveguides, and  
a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode operable to tune a temperature sensitivity of the plurality of electro-optical waveguides.

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11. The semiconductor structure of claim 9, wherein:  
the arrayed wavelength grating device further includes  
a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and  
30 a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode

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operable to tune a polarization-dependent wavelength of the plurality of electro-optical waveguides.

12. The semiconductor structure of claim 9, wherein:
- 5 the arrayed wavelength grating device further includes
- a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and
- a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode
- 10 operable to tune a channel wavelength offset of the plurality of electro-optical waveguides.

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13. A process for fabricating a semiconductor structure comprising:  
providing a monocrystalline silicon substrate ;  
depositing a monocrystalline perovskite oxide film overlying the  
5 monocrystalline silicon substrate , the film having a thickness less than a thickness of  
the material that would result in strain-induced defects;  
forming an amorphous oxide interface layer containing at least silicon and  
oxygen at an interface between the monocrystalline perovskite oxide film and the  
monocrystalline silicon substrate;  
10 epitaxially forming a monocrystalline compound semiconductor layer overlying  
the monocrystalline perovskite oxide film; and  
forming an arrayed wavelength grating device overlying the monocrystalline  
silicon substrate .
14. The process of claim 13, wherein:  
the arrayed wavelength grating device functions as a multiplexer.
15. The process of claim 13, wherein:  
the arrayed wavelength grating device functions as a demultiplexer.
- 20 16. The process of claim 13, wherein:  
the arrayed wavelength grating device functions as a router.
17. The process of claim 13, wherein:  
25 the arrayed wavelength grating device functions as a switch.
18. The process of claim 13, wherein:  
a temperature sensitivity of the arrayed wavelength grating device is tunable.
- 30 19. The process of claim 13, wherein:  
a polarization dependent wavelength of the arrayed wavelength grating device  
is tunable.

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20. The process of claim 13, wherein:

a channel wavelength offset of the arrayed wavelength grating device is tunable.

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21. The process of claim 13, wherein the

the arrayed wavelength grating device includes

a plurality of electro-optical waveguides formed within the  
monocrystalline compound semiconductor layer, each waveguide of the plurality of  
10 electro-optical waveguides carrying an optical signal of a distinct wavelength, and  
a first electrode formed in the monocrystalline compound  
semiconductor layer and above the plurality of electro-optical waveguides, the first  
electrode operable to provide a distinct phase shift to each waveguide of the plurality  
of electro-optical waveguides in response to an application of voltage to the first  
15 electrode.

22. The process of claim 21, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality  
20 of electro-optical waveguides, and  
a second electrode formed in the monocrystalline compound  
semiconductor layer and above the planar waveguide region, the second electrode  
operable to tune a temperature sensitivity of the plurality of electro-optical  
waveguides.

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23. The process of claim 21, wherein:

the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality  
of electro-optical waveguides, and  
30 a second electrode formed in the monocrystalline compound  
semiconductor layer and above the planar waveguide region, the second electrode

operable to tune a polarization-dependent wavelength of the plurality of electro-optical waveguides.

24. The process of claim 21, wherein:

5 the arrayed wavelength grating device further includes

a planar waveguide region in optical communication with the plurality of electro-optical waveguides, and

a second electrode formed in the monocrystalline compound semiconductor layer and above the planar waveguide region, the second electrode  
10 operable to tune a channel wavelength offset of the plurality of electro-optical waveguides.

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